

SEQUENCE LISTING

<110> Hexima Limited  
La Trobe University  
Anderson, Marilyn, Anne (US ONLY)  
Heath, Robyn, Louise (US ONLY)  
Dunse, Kerry, Michelle (US ONLY)

<120> Novel insect enzymes and inhibitors thereof

<130> 12440340/EJH  
<140> 10/554,237  
<150> US 60/465,054  
<151> 2003-04-23

<160> 93

<170> PatentIn version 3.2

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Glu Glu Lys Lys Asn  
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Ile Val Gly Gly Ser Leu Ser Ser Val Gly Gln Ile Pro Tyr Gln Ala  
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Gly Leu Val Ile Asp Leu Ala Gly Gly Gln Ala Val Cys Gly Gly Ser  
20 25 30

Leu Ile Ser Ala Ser Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp  
35 40 45

Gly Gln Asn Gln Ala Trp Arg Phe Thr Val Val Leu Val Met His Gly  
50 55 60

Ser Trp Thr Pro Ser Leu Ile Arg Asn Asp Val Ala Val Ile Arg Leu  
65 70 75 80

Gly Thr Asn Val Ala Thr Ser Asn Thr Ile Ala Ile Ile Ala Leu Pro  
85 90 95

Ser Gly Ser Gln Ile Asn Glu Asn Phe Ala Gly Glu Thr Ala Leu Ala  
100 105 110

Ser Gly Phe Gly Leu Thr Ser Asp Thr Gly Ser Ile Ser Ser Asn Gln  
115 120 125

Ala Leu Ser His Val Asn Leu Pro Val Ile Thr Asn Ala Val Cys Arg  
130 135 140

Asn Ser Phe Pro Leu Leu Ile Gln Asp Ser Asn Ile Cys Thr Ser Gly  
145 150 155 160

Ala Asn Gly Arg Ser Thr Cys Arg Gly Asp Ser Gly Gly Pro Leu Val  
165 170 175

Val Thr Arg Asn Asn Arg Pro Leu Leu Ile Gly Ile Thr Ser Phe Gly  
180 185 190

Ser Ala Arg Gly Cys Gln Val Gly Ser Pro Ala Ala Phe Ala Arg Val  
195 200 205

Thr Ser Tyr Ile Ser Trp Ile Asn Gly Gln Leu  
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<210> 3  
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<400> 3

Val His Leu Glu Asp Ser Ile Asp Leu Glu Asp Ile Thr Ala Trp Gly  
1 5 10 15

Tyr Leu Thr Lys Phe Gly Ile Pro Glu Ala Glu Lys Ile Arg Asn Ala  
20 25 30

Glu Glu Ala Ser Ser Ala Ser Arg  
35 40

<210> 4  
<211> 708  
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<400> 4  
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gacttagcag gtggccaggc tgtctgcgga ggctccctga tcagcgcttc ccgcgtactg 120  
accgctgctc actgctgggt cgacggccaa aaccaggcct ggagattcac cgttgttctt 180  
ggttccacca ccttgttctc tggcggtacc agaatcccta catccaatgt tgttatgcac 240  
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gtagcaacct caaacaccat tgccatcatc gctctacca gggcagcca gatcaacgag 360  
aacttcgccg gtgaaaccgc cctcgctcc ggcttcggtc tcaccagtga caccggcagc 420  
atctccagca accaggctct gagccacgtc aacctgccag tgatcaccaa cgctgtgtgc 480  
agaaattcat tccccctgct gatccaggac tctaacattt gcaccagcgg tgccaacggc 540  
aggagcactt gccgcggtga ctccggcggt cctctcgctg tcaccaggaa caacagacca 600  
ctcttgatcg gtatcacctc tttcggatct gccgcgggtt gccaagttgg atctcccgt 660  
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<213> Helicoverpa sp

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ttcggtatcc cagaagctga gaaaatccgc aacgctgaag aagctagctc tgctagcagg 120  
atcgtcggtg gttcattgtc cagtgtcgga cagatccctt accaggctgg tctcgtcatt 180  
gacttagcag gtggccaggc tgtctgcgga ggctccctga tcagcgcttc ccgcgtactg 240

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accgctgctc actgctgggt cgacggccaa aaccaggcct ggagattcac cgttgttctt 300
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ggaagctgga ctctagcct tatccgtaac gatggtgccc taatcagatt gggcaccaac 420
gtagcaacct caaacaccat tgccatcatc gctctacca gcggcagcca gatcaacgag 480
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<211> 34
<212> DNA
<213> artificial sequence

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<223> HindIII oligonucleotide primer

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Gly Leu Val Ile Asp Leu Ala Gly Gly Gln Ala Val Cys Gly Gly Ser  
 20 25 30

Leu Ile Ser Ala  
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<210> 10  
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 <223> Fw2ResChy primer

<400> 10  
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<210> 11  
 <211> 35  
 <212> DNA  
 <213> artificial sequence

<220>  
 <223> FwResChym primer

<400> 11  
 gtagctatac tgactctagc tgcagctgga gctgg

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<210> 12  
 <211> 21  
 <212> DNA  
 <213> artificial sequence

<220>  
 <223> Hc35PQE-6-Fw primer

<400> 12  
 ttaaccatgg tgatcgacct c

21

<210> 13  
<211> 23  
<212> DNA  
<213> artificial sequence

<220>  
<223> Hc35PQ-60-Rv primer

<400> 13  
gatgagatct gagacgttgg ttg 23

<210> 14  
<211> 25  
<212> DNA  
<213> artificial sequence

<220>  
<223> gene specific sense primer

<400> 14  
cgggatccat ggagtcaaag tttgc 25

<210> 15  
<211> 25  
<212> DNA  
<213> artificial sequence

<220>  
<223> gene specific antisense primer

<400> 15  
gcgtcgacgc ttaagccacc ctagg 25

<210> 16  
<211> 24  
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<223> StPOTIA sense primer

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cgggatccaa ggaatcggaa tctg 24

<210> 17  
<211> 23  
<212> DNA  
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<223> StPOTIB sense primer

<400> 17  
cgggatccaa ggaatttgaa tgc

23

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<211> 22  
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<223> StPOTIA/B antisense primer

<400> 18  
cgagctctta agccacccta gg

22

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<223> FWBacRECHI (5'-3') primer

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ttggctttcg ccgcggtcgt ctccgcgagg aacgggtccc

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<223> FWBacRECH2 (5'-3') primer

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<400> 21  
 gatcaacggc cagctctaaa agctt

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 <213> Nicotiana alata

<400> 22

Met Ala Val His Arg Val Ser Phe Leu Ala Leu Leu Leu Leu Phe Gly  
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Met Ser Leu Leu Val Ser Asn Val Glu His Ala Asp Ala Lys Ala Cys  
 20 25 30

Thr Leu Asn Cys Asp Pro Arg Ile Ala Tyr Gly Val Cys Pro Arg Ser  
 35 40 45

Glu Glu Lys Lys Asn  
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<210> 23  
 <211> 58  
 <212> PRT  
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<400> 23

Asp Arg Ile Cys Thr Asn Cys Cys Ala Gly Thr Lys Gly Cys Lys Tyr  
 1 5 10 15

Phe Ser Asp Asp Gly Thr Phe Val Cys Glu Gly Glu Ser Asp Pro Arg  
 20 25 30

Asn Pro Lys Ala Cys Thr Leu Asn Cys Asp Pro Arg Ile Ala Tyr Gly  
 35 40 45

Val Cys Pro Arg Ser Glu Glu Lys Lys Asn  
 50 55



<210> 24  
<211> 58  
<212> PRT  
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<400> 24

Asp Arg Ile Cys Thr Asn Cys Cys Ala Gly Thr Lys Gly Cys Lys Tyr  
1 5 10 15

Phe Ser Asp Asp Gly Thr Phe Val Cys Glu Gly Glu Ser Asp Pro Arg  
20 25 30

Asn Pro Lys Ala Cys Pro Arg Asn Cys Asp Pro Arg Ile Ala Tyr Gly  
35 40 45

Ile Cys Pro Leu Ala Glu Glu Lys Lys Asn  
50 55

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<212> PRT  
<213> Nicotiana alata

<400> 25

Asp Arg Ile Cys Thr Asn Cys Cys Ala Gly Lys Lys Gly Cys Lys Tyr  
1 5 10 15

Phe Ser Asp Asp Gly Thr Phe Val Cys Glu Gly Glu Ser Asp Pro Lys  
20 25 30

Asn Pro Lys Ala Cys Pro Arg Asn Cys Asp Gly Arg Ile Ala Tyr Gly  
35 40 45

Ile Cys Pro Leu Ser Glu Glu Lys Lys Asn  
50 55

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<211> 58  
<212> PRT  
<213> Nicotiana alata

<400> 26

Asp Arg Ile Cys Thr Asn Cys Cys Ala Gly Lys Lys Gly Cys Lys Tyr  
1 5 10 15

Phe Ser Asp Asp Gly Thr Phe Val Cys Glu Gly Glu Ser Asp Pro Arg  
20 25 30

Asn Pro Lys Ala Cys Pro Arg Asn Cys Asp Gly Arg Ile Ala Tyr Gly  
35 40 45

Ile Cys Pro Leu Ser Glu Glu Lys Lys Asn  
50 55

<210> 27  
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<213> Nicotiana alata

<400> 27

Asp Arg Ile Cys Thr Asn Cys Cys Ala Gly Lys Lys Gly Cys Lys Tyr  
1 5 10 15

Phe Ser Asp Asp Gly Thr Phe Ile Cys Glu Gly Glu Ser Glu Tyr Ala  
20 25 30

Ser Lys Val Asp Glu Tyr Val Gly Glu Val Glu Asn Asp Leu Gln Lys  
35 40 45

Ser Lys Val Ala Val Ser  
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<210> 28  
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<212> PRT  
<213> Helicoverpa sp

<400> 28

Ile Val Gly Gly Ser Leu Ser Ser Val Gly Gln Ile Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Val Ile Asp Leu Ala Gly Gly Gln Ala Val Cys Gly Gly Ser  
20 25 30

Leu Ile Ser Ala  
35

<210> 29  
<211> 29  
<212> PRT  
<213> Helicoverpa sp

<400> 29

Ile Val Gly Gly Ser Ile Ser Ser Ile Gly Gln Ile Pro Tyr Gly Ala  
1 5 10 15

Gly Leu Val Ile Asp Phe Ala Gly Gly Gln Ala Val Cys  
20 25

<210> 30  
<211> 29  
<212> PRT  
<213> Helicoverpa sp

<400> 30

Ile Val Gly Gly Ser Thr Ser Ser Val Gly Gln Phe Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Leu Ala Ser Phe Ala Gly Gly Gln Ala Val Cys  
20 25

<210> 31  
<211> 29  
<212> PRT  
<213> Helicoverpa sp

<400> 31

Ile Val Gly Gly Ser Val Thr Thr Leu Asp Ala Tyr Pro Thr Ile Ala  
1 5 10 15

Gly Leu Val Tyr Asn Phe Ala Gly Gly Gln Ala Val Cys  
20 25

<210> 32  
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 <212> PRT  
 <213> Helicoverpa armigera

<400> 32

Met Lys Leu Leu Ala Val Thr Leu Leu Ala Phe Ala Ala Val Val Ser  
 1 5 10 15

Ala Arg Asn Ile Asp Leu Glu Asp Val Ile Asp Leu Glu Asp Ile Thr  
 20 25 30

Ala Tyr Asp Tyr His Thr Lys Ile Gly Ile Pro Leu Ala Glu Lys Ile  
 35 40 45

Arg Ala Ala Glu Glu Glu Ala Glu Arg Asn Pro Ser Arg Ile Val Gly  
 50 55 60

Gly Ser Thr Ser Ser Leu Gly Ala Phe Pro Tyr Gln Ala Gly Leu Leu  
 65 70 75 80

Ala Thr Phe Ala Ser Gly Gln Gly Val Cys Gly Gly Ser Leu Leu Asn  
 85 90 95

Asn Arg Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp Gly Arg Asn  
 100 105 110

Gln Ala Arg Ser Phe Thr Val Val Leu Gly Ser Val Arg Leu Phe Ser  
 115 120 125

Gly Gly Thr Arg Leu Asn Thr Ala Ser Val Val Met His Gly Ser Trp  
 130 135 140

Asn Pro Asn Leu Ile Arg Asn Asp Ile Ala Met Ile Asn Leu Pro Ser  
 145 150 155 160

Asn Val Ala Thr Ser Gly Asn Ile Ala Pro Ile Ala Leu Pro Ser Gly  
 165 170 175

Asn Glu Leu Asn Asn Asn Phe Asn Gly Ala Thr Ala Val Ala Ser Gly  
 180 185 190

Phe Gly Leu Ala Arg Asp Gly Gly Ser Val Asp Gly Asn Leu Arg His  
 195 200 205

Val Asn Leu Pro Val Ile Thr Asn Ala Val Cys Thr Val Ser Phe Pro  
210 215 220

Gly Ile Ile Gln Ser Ser Asn Ile Cys Thr Ser Gly Ala Asn Gly Arg  
225 230 235 240

Ser Thr Cys Gln Gly Asp Ser Gly Gly Pro Leu Val Val Thr Ser Asn  
245 250 255

Asn Arg Arg Ile Leu Ile Gly Val Thr Ser Phe Gly Ser Ala Arg Gly  
260 265 270

Cys Gln Val Gly Ser Pro Ala Ala Phe Ala Arg Val Thr Ser Phe Ile  
275 280 285

Ser Trp Ile Asn Gln Arg Leu  
290 295

<210> 33  
<211> 292  
<212> PRT  
<213> Helicoverpa armigera

<400> 33

Leu Ala Val Thr Leu Leu Ala Phe Ala Ala Val Val Ser Ala Arg Asn  
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Ile Asp Leu Glu Asp Val Ile Asp Leu Glu Asp Ile Thr Ala Tyr Asp  
20 25 30

Tyr His Thr Lys Ile Gly Ile Pro Leu Ala Glu Lys Ile Arg Ala Ala  
35 40 45

Glu Glu Glu Ala Glu Arg Asn Pro Ser Arg Ile Val Gly Gly Ser Thr  
50 55 60

Ser Ser Leu Gly Ala Phe Pro Tyr Gln Ala Gly Leu Leu Ala Thr Phe  
65 70 75 80

Ala Ser Gly Gln Gly Val Cys Gly Gly Ser Leu Leu Asn Asn Arg Arg  
85 90 95

Val Leu Thr Ala Ala His Cys Trp Phe Asp Gly Arg Asn Gln Ala Arg  
100 105 110

Ser Phe Thr Val Val Leu Gly Ser Val Arg Leu Phe Ser Gly Gly Thr  
115 120 125

Arg Leu Asn Thr Ala Ser Val Val Met His Gly Ser Trp Asn Pro Asn  
130 135 140

Leu Ile Arg Asn Asp Ile Ala Met Ile Asn Leu Pro Ser Asn Val Ala  
145 150 155 160

Thr Ser Gly Asn Ile Ala Pro Ile Ala Leu Pro Ser Gly Asn Glu Leu  
165 170 175

Asn Asn Asn Phe Asn Gly Ala Thr Ala Val Ala Ser Gly Phe Gly Leu  
180 185 190

Ala Arg Asp Gly Gly Ser Val Asp Gly Asn Leu Arg His Val Asn Leu  
195 200 205

Pro Val Ile Thr Asn Ala Val Cys Thr Val Ser Phe Pro Gly Ile Ile  
210 215 220

Gln Ser Ser Asn Ile Cys Thr Ser Gly Ala Asn Gly Arg Gly Thr Cys  
225 230 235 240

Gln Gly Asp Ser Gly Gly Pro Leu Val Val Thr Ser Asn Asn Arg Arg  
245 250 255

Ile Leu Ile Gly Val Thr Pro Phe Gly Ser Ala Arg Gly Cys Gln Val  
260 265 270

Gly Ser Pro Ala Ala Phe Ala Arg Val Thr Ser Phe Ile Ser Trp Ile  
275 280 285

Asn Gln Arg Leu  
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 <213> Helicoverpa armigera

<400> 34

Met Lys Leu Leu Ala Val Thr Leu Leu Ala Phe Ala Ala Ile Val Ser  
 1 5 10 15

Ala Arg Asn Ile Asp Leu Glu Asp Val Ile Asp Leu Glu Asp Ile Thr  
 20 25 30

Ala Tyr Asp Tyr His Thr Lys Ile Gly Ile Pro Leu Ala Glu Lys Ile  
 35 40 45

Arg Ala Ala Glu Glu Glu Ala Glu Arg Asn Pro Ser Arg Ile Val Gly  
 50 55 60

Gly Ser Ile Ser Ser Leu Gly Ala Phe Pro Tyr Gln Ala Gly Leu Leu  
 65 70 75 80

Ala Thr Phe Ala Ser Gly Gln Gly Val Cys Gly Gly Ser Leu Leu Asn  
 85 90 95

Asn Arg Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp Gly Arg Asn  
 100 105 110

Gln Ala Arg Ser Phe Thr Val Val Leu Gly Ser Val Arg Leu Phe Ser  
 115 120 125

Gly Gly Thr Arg Leu Asn Thr Ala Ser Val Val Met His Gly Ser Trp  
 130 135 140

Asn Pro Asn Leu Ile Arg Asn Asp Ile Ala Ile Ile Asn Leu Pro Ser  
 145 150 155 160

Asn Val Ala Thr Ser Gly Asn Ile Ala Pro Ile Ala Leu Pro Ser Gly  
 165 170 175

Asn Glu Leu Asn Asn Asn Phe Asn Gly Ala Thr Ala Val Ala Ser Gly  
 180 185 190

Phe Gly Leu Ala Asn Asp Gly Gly Ser Val Asp Gly Asn Leu Arg His  
 195 200 205

Val Asn Leu Pro Val Ile Thr Asn Ala Val Cys Thr Val Ser Phe Pro  
210 215 220

Gly Ile Ile Gln Ser Ser Asn Ile Cys Thr Ser Gly Ala Asn Gly Arg  
225 230 235 240

Ser Thr Cys Gln Gly Asp Ser Gly Gly Pro Leu Val Val Thr Ser Asn  
245 250 255

Asn Arg Arg Ile Leu Ile Gly Val Thr Ser Phe Gly Ser Ala Arg Gly  
260 265 270

Cys Gln Val Gly Ser Pro Ala Ala Phe Ala Arg Val Thr Ser Phe Ile  
275 280 285

Ser Trp Ile Asn Asn Leu Leu  
290 295

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<213> Helicoverpa armigera

<400> 35

Ile Asn His Glu Ala Val Val Asp Leu Glu Asp Ile Thr Ala Tyr Gly  
1 5 10 15

Tyr His Thr Lys Val Gly Ile Pro Leu Ala Glu Glu Ile Arg Ile Ala  
20 25 30

Glu Leu Glu Ala Ser Arg Asn Pro Ser Arg Ile Val Gly Gly Ser Ser  
35 40 45

Ala Ser Leu Gly Gln Phe Pro Tyr Gln Ala Gly Leu Leu Ile Asn Leu  
50 55 60

Pro Leu Gly Gln Ser Val Cys Gly Gly Ser Leu Leu Asn Gln Arg Arg  
65 70 75 80

Val Leu Thr Ala Ala His Cys Trp Phe Asp Gly Arg Asn Gln Ala Asn  
85 90 95



Ser Leu Thr Val Ile Leu Gly Ser Ile Asn Leu Tyr Phe Gly Gly Thr  
100 105 110

Arg Leu Asn Ser Asn Ser Val Val Met His Gly Ser Trp Asn Pro Asn  
115 120 125

Leu Ile Arg Asn Asp Ile Ala Ile Ile Asn Leu Pro Ser Asn Val Gly  
130 135 140

Thr Ser Asn Asn Ile Ala Pro Ile Ala Leu Pro Ser Gly Asn Glu Leu  
145 150 155 160

Asn Asn Gln Phe Ala Gly Phe Thr Ala Thr Ala Ser Gly Phe Gly Arg  
165 170 175

Thr Arg Asp Gly Gly Ser Val Ser Pro Thr Leu Asn His Val Asn Leu  
180 185 190

Pro Val Ile Thr Asn Asn Val Cys Trp Gln Ser Phe Pro Leu Tyr Ile  
195 200 205

Gln Ser Ser Asn Ile Cys Thr Ser Gly Ala Asn Gly Arg Ser Thr Cys  
210 215 220

Gln Gly Asp Ser Gly Gly Pro Leu Val Val Thr Ser Asn Asn Arg Arg  
225 230 235 240

Ile Leu Ile Gly Val Thr Ser Phe Gly Ser Asp Arg Gly Cys Gln Val  
245 250 255

Gly Ala Pro Ala Ala Phe Ala Arg Val Thr Ser Tyr Ile Ser Trp Ile  
260 265 270

Asn Gln Arg Leu  
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<210> 36  
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<400> 36

Met Lys Leu Phe Leu Gly Val Cys Leu Thr Leu Ala Val Ala Val Ser  
 1 5 10 15

Ala Val Glu Ile Ala Thr Pro Asp Ala Asp Ser Pro Val Phe Gly Tyr  
 20 25 30

His Ala Lys Phe Gly Ile Ala Glu Ala Ala Arg Ile Lys Ser Ala Glu  
 35 40 45

Glu Val Gln Ser Phe Asn Gly Gln Arg Ile Val Gly Gly Ser Ile Thr  
 50 55 60

Asn Ile Ala Asn Val Pro Tyr Gln Ala Gly Leu Val Ile Thr Ile Phe  
 65 70 75 80

Ile Phe Gln Ser Val Cys Gly Ala Ser Leu Ile Ser His Asn Arg Leu  
 85 90 95

Val Thr Ala Ala His Cys Lys Ser Asp Gly Val Leu Thr Ala Asn Ser  
 100 105 110

Phe Thr Val Val Leu Gly Ser Asn Thr Leu Phe Phe Gly Gly Thr Arg  
 115 120 125

Ile Asn Thr Asn Asp Val Val Met His Pro Asn Trp Asn Pro Asn Thr  
 130 135 140

Ala Ala Asn Asp Ile Ala Val Leu Arg Ile Ser Ser Val Ser Phe Ser  
 145 150 155 160

Asn Val Ile Gln Pro Ile Ala Leu Pro Ser Gly Asp Glu Leu Asn Asn  
 165 170 175

Leu Phe Val Gly Ala Asn Ala Leu Ala Ser Gly Phe Gly Arg Thr Ser  
 180 185 190

Asp Ser Gly Ser Ile Gly Thr Asn Gln Gln Leu Ser Ser Val Thr Ile  
 195 200 205

Pro Val Ile Thr Asn Ala Gln Cys Ala Ala Val Tyr Gly Ser Gly Phe  
210 215 220

Val His Ala Ser Asn Ile Cys Thr Ser Gly Ala Gly Gly Lys Gly Thr  
225 230 235 240

Cys Asn Gly Asp Ser Gly Gly Pro Leu Ala Val Asp Ser Asn Asn Arg  
245 250 255

Lys Ile Leu Ile Gly Val Thr Ser Tyr Gly Ala Gln Ala Gly Cys Ala  
260 265 270

Ala Gly Phe Pro Ala Ala Phe Ala Arg Val Thr Ser Phe Val Asp Trp  
275 280 285

Val Gln Ser Gln  
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<210> 37  
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<212> PRT  
<213> Helicoverpa armigera

<400> 37

His Asn Lys Trp Val Leu Thr Ala Ala His Cys Leu Ala Asn Arg Ile  
1 5 10 15

Thr Phe Val Val Arg Phe Gly Leu Thr Asn Leu Thr Arg Pro Glu Ile  
20 25 30

Leu Val Glu Ser Ala Asn Lys Tyr Ile His Pro Asp Tyr Asp Glu Ile  
35 40 45

Arg Ala Gly Val Gln Thr Ala Asp Leu Ala Leu Val Gly Leu Asp His  
50 55 60

His Ile Glu Tyr Ser Ala Asn Val Gln Pro Ser Arg Leu Met Ser Ser  
65 70 75 80

Ala Gln Lys Asn Ile Asn Tyr Glu Gly Ile Gln Met Ile Val Ser Gly  
85 90 95

Phe Gly Arg Thr Asp Asp Leu Trp Asn Gly Gly Ala Ala Ser Glu Ile  
 100 105 110

Leu Leu Trp Val Tyr Gln Arg Gly Val Ser Asn Glu Glu Cys Leu Arg  
 115 120 125

Trp Tyr Pro Thr Ser Gln Val Ile Lys Glu Glu Thr Ile Cys Ala Gly  
 130 135 140

Tyr Trp Asp Asn Pro Ser Gln Ser Ser Cys Gln Gly Asp Ser Gly Gly  
 145 150 155 160

Pro Leu Thr Ile Ile Asp Ala Asp Gly Glu Arg Thr Gln Val Gly Ile  
 165 170 175

Val Ser Phe Gly Ser Thr Ala Gly Cys Asn Ser Pro Phe Pro Ser Gly  
 180 185 190

Tyr Val Arg Pro Gly His Tyr His Asp Trp Phe Thr Glu Val Thr Gly  
 195 200 205

Ile Asn Phe Asp Trp Asp Ser Asp Ala Ile Ile Pro Gly Ser Ser Glu  
 210 215 220

Ser Glu Glu Asp Gly Ser Asn Pro Ser Ser Glu Glu Asp Ala Gly Ser  
 225 230 235 240

Pro Pro Ser Glu Glu Glu Glu Ala Pro Glu Lys Val Arg Val Val Glu  
 245 250 255

Tyr

<210> 38  
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 <212> DNA  
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tctggcgaag gcagcagg

18

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ctgctagcct cggacaattc

20

<210> 41  
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ctggagtgca gactgctgac

20

<210> 42  
<211> 20  
<212> DNA  
<213> artificial sequence

<220>  
<223> Y72Rv primer

<400> 42  
ggatgatggc gtcgctgtcc

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<210> 43  
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 <212> PRT  
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<400> 43

Pro Tyr Gln Ala Gly Leu Val Ile Thr Ile Phe Ile Phe Gln Ser Val  
 1 5 10 15

Cys Gly Ala Ser Leu Ile Pro His Asn Arg Leu Val Thr Ala Ala His  
 20 25 30

Cys Lys Ser Asp Gly Val Leu Thr Ala Asn Ser Phe Thr Val Val Leu  
 35 40 45

Gly Ser Asn Thr Leu Phe Phe Gly Gly Thr Arg Ile Asn Thr Asn Asp  
 50 55 60

Val Val Met His Pro Asn Trp Asn Pro Ser Thr Ala Ala Asn Asp Ile  
 65 70 75 80

Ala Val Met Arg Ile Ser Ser Val Ser Phe Ser Asn Val Ile Gln Pro  
 85 90 95

Ile Ala Leu Pro Ser Gly Asp Glu Leu Asn Asn Leu Phe Val Gly Ala  
 100 105 110

Asn Ala Leu Ala Ser Gly Phe Gly Arg Thr Ser Asp Gly Gly Ser Ile  
 115 120 125

Gly Ser Asn Gln Gln Val Ser Ser Val Thr Ile Pro Val Ile Thr Asn  
 130 135 140

Asp Glu Cys Ala Ala Val Tyr Gly Ser Ala Phe Val His Ser Ser Asn  
 145 150 155 160

Ile Cys Thr Ser Gly Ala Gly Gly Lys Gly Thr Cys Asn Gly Asp Ser  
 165 170 175

Gly Gly Pro Leu Ala Ile Asp Ser Asn Asn Glu Lys Ile Leu Ile Gly  
 180 185 190

Val Thr Ser Tyr Gly Ala Gln Ala Gly Cys Ala Ala Gly Leu Pro Ala  
 195 200 205

Ala Phe Ala Arg Lys  
210

<210> 44  
<211> 213  
<212> PRT  
<213> Helicoverpa punctigera

<400> 44

Pro Tyr Gln Ala Gly Leu Val Ile Thr Ile Phe Ile Phe Gln Ser Val  
1 5 10 15

Cys Gly Ala Ser Leu Ile Ser His Asn Arg Leu Val Thr Ala Ala His  
20 25 30

Cys Lys Phe Asp Gly Val Met Thr Ala Asn Ser Phe Thr Val Val Leu  
35 40 45

Gly Ser Asn Thr Leu Phe Phe Gly Gly Thr Arg Ile Asn Thr Asn Asp  
50 55 60

Val Val Met His Pro Asn Trp Asn Pro Ser Thr Val Ala Asn Asp Ile  
65 70 75 80

Ala Val Ile Arg Ile Ser Ser Ile Val Phe Asn Asn Val Ile Gln Pro  
85 90 95

Ile Ala Leu Pro Ser Gly Asp Glu Leu Asn Asn Leu Phe Val Gly Ala  
100 105 110

Asn Ala Leu Ala Ser Gly Phe Gly Arg Thr Ser Asp Ser Gly Gly Ile  
115 120 125

Gly Thr Asn Gln Gln Leu Ser Ser Val Thr Ile Pro Val Ile Thr Asn  
130 135 140

Ala Glu Cys Ala Ala Val Tyr Gly Pro Ala Phe Val His Asp Thr Asn  
145 150 155 160

Ile Cys Thr Ser Gly Ala Gly Gly Lys Gly Thr Cys Asn Gly Asp Ser  
165 170 175

Gly Gly Pro Leu Ala Val Asp Ser Asn Asp Lys Lys Ile Leu Ile Gly  
180 185 190

Val Thr Ser Tyr Gly Ala Ala Asp Gly Cys Ala Ala Gly Phe Pro Ala  
195 200 205

Ala Ser Pro Glu Arg  
210

<210> 45  
<211> 177  
<212> PRT  
<213> Helicoverpa punctigera

<400> 45

Pro Tyr Gln Ala Gly Leu Leu Ala Asn Phe Ala Ser Gly Gln Gly Val  
1 5 10 15

Cys Gly Gly Ser Leu Leu Asn Gln Arg Arg Val Leu Thr Ala Ala His  
20 25 30

Cys Trp Phe Asp Gly Arg Asn Gln Ala Arg Ser Phe Thr Val Val Leu  
35 40 45

Gly Ser Val Arg Leu Phe Ser Gly Gly Thr Arg Leu Asp Thr Ala Ser  
50 55 60

Val Val Met His Gly Ser Trp Asn Pro Asn Leu Ile Arg Asn Asp Ile  
65 70 75 80

Ala Met Ile Asn Leu Pro Ser Asn Val Ala Thr Ser Gly Asn Ile Ala  
85 90 95

Pro Ile Ala Leu Pro Ser Gly Asn Glu Leu Asn Asn Asn Phe Asn Gly  
100 105 110

Ala Thr Ala Thr Ala Ser Gly Phe Gly Leu Ala Arg Asp Gly Gly Ser  
115 120 125

Val Asp Gly Asn Leu Arg His Val Asn Leu Pro Val Ile Thr Asn Ala  
130 135 140

Val Cys Thr Val Ser Phe Pro Gly Ile Ile Gln Ser Ser Asn Ile Cys  
145 150 155 160



Thr Ser Gly Ala Asn Gly Arg Ser Thr Cys Gln Gly Asp Ser Gly Gly  
165 170 175

Pro

<210> 46  
<211> 217  
<212> PRT  
<213> Helicoverpa punctigera

<400> 46

Ser Ala Ser Leu Gly Gln Phe Pro Tyr Gln Ala Gly Leu Leu Ile Asn  
1 5 10 15

Leu Pro Leu Gly Gln Ser Val Cys Gly Gly Ser Leu Leu Asn Gln Arg  
20 25 30

Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp Gly Arg Asn Gln Ala  
35 40 45

Thr Ser Leu Thr Val Ile Leu Gly Ser Ile Asn Leu Phe Phe Gly Gly  
50 55 60

Thr Arg Leu Asn Ser Asn Ser Val Val Met His Gly Ser Trp Asn Pro  
65 70 75 80

Asn Leu Ile Arg Asn Asp Ile Ala Ile Ile Asn Leu Pro Ser Asn Val  
85 90 95

Gly Thr Ser Gly Asn Ile Ala Pro Ile Ala Leu Pro Ser Gly Asn Glu  
100 105 110

Leu Asn Asn Gln Phe Ala Gly Phe Thr Ala Thr Ala Ser Gly Phe Gly  
115 120 125

Leu Thr Arg Asp Gly Gly Asn Val Ser Pro Thr Leu Asn His Val Asn  
130 135 140

Leu Pro Val Ile Thr Asn Asn Val Cys Trp Gln Ser Phe Pro Leu Tyr  
145 150 155 160

Ile Gln Ser Thr Asn Ile Cys Thr Ser Gly Ala Asn Gly Arg Gly Thr  
165 170 175

Cys Gln Gly Asp Ser Gly Gly Pro Leu Val Val Thr Ser Asn Asn Arg  
180 185 190

Arg Ile Leu Ile Gly Val Thr Ser Phe Gly Ser Asp Arg Gly Cys Gln  
195 200 205

Val Gly Ala Pro Ala Ala Phe Ala Arg  
210 215

<210> 47  
<211> 170  
<212> PRT  
<213> Helicoverpa punctigera

<400> 47

Ser Gly Val Gln Thr Ala Asp Leu Ala Leu Val Gly Leu Asp Gln Glu  
1 5 10 15

Ile Glu Tyr Ser Ala Asn Val Gln Pro Ser Arg Leu Met Ser Ser Ala  
20 25 30

Gln Lys Asn Ile Asn Tyr Glu Gly Ile Gln Met Ile Val Ser Gly Phe  
35 40 45

Gly Arg Thr Asp Asp Leu Trp Asn Gly Gly Ala Ala Ser Glu Ile Leu  
50 55 60

Leu Trp Val Tyr Gln Arg Gly Val Ser Asn Glu Glu Cys Leu Arg Trp  
65 70 75 80

Tyr Pro Thr Ser Gln Val Ile Lys Glu Gln Thr Ile Cys Ala Gly Tyr  
85 90 95

Trp Asp Asn Pro Ser Gln Ser Ser Cys Gln Gly Asp Ser Gly Gly Pro  
100 105 110

Leu Thr Ile Ile Asp Ala Asp Gly Glu Arg Thr Gln Val Gly Ile Val  
115 120 125

Ser Phe Gly Ser Thr Ala Gly Cys Asn Ser Pro Phe Pro Ser Gly Tyr  
130 135 140

Val Arg Pro Gly His Tyr His Asp Trp Phe Thr Glu Val Thr Gly Ile  
145 150 155 160

Asn Phe Asp Trp Asp Ser Asp Ala Ile Ile  
165 170

<210> 48  
<211> 279  
<212> PRT  
<213> Helicoverpa punctigera

<400> 48

Ala Val Ser Ala Val Glu Ile Gly Thr Pro Asp Ala Asp Ser Pro Val  
1 5 10 15

Phe Gly Tyr His Ala Lys Phe Gly Ile Pro Glu Ala Ala Arg Ile Lys  
20 25 30

Ser Ala Glu Glu Val Gln Ser Phe Asn Gly Gln Arg Ile Val Gly Gly  
35 40 45

Ser Ile Thr Asp Ile Ala Asn Val Pro Tyr Gln Ala Gly Leu Val Ile  
50 55 60

Thr Ile Phe Ile Phe Gln Ser Val Cys Gly Ala Ser Leu Ile Ser His  
65 70 75 80

Asn Arg Leu Val Thr Ala Ala His Cys Lys Ser Asp Gly Val Leu Thr  
85 90 95

Ala Asn Ser Phe Thr Val Val Leu Gly Ser Asn Thr Leu Phe Phe Gly  
100 105 110

Gly Thr Arg Ile Asn Thr Asn Asp Val Val Met His Pro Asn Trp Asn  
115 120 125

Pro Ser Thr Ala Ala Asn Asp Ile Ala Val Met Arg Ile Ser Ser Val  
130 135 140

Ser Phe Ser Asn Val Ile Gln Pro Ile Ala Leu Pro Ser Gly Asp Glu  
145 150 155 160

Leu Asn Asn Leu Phe Val Gly Ala Asn Ala Leu Ala Ser Gly Phe Gly  
165 170 175

Arg Thr Ser Asp Gly Gly Ser Ile Gly Ser Asn Gln Gln Val Ser Ser  
180 185 190

Val Thr Ile Pro Val Ile Thr Asn Asp Glu Cys Ala Ala Val Tyr Gly  
195 200 205

Ser Ala Phe Val His Ser Ser Asn Ile Cys Thr Ser Gly Ala Gly Gly  
210 215 220

Lys Gly Thr Cys Asn Gly Asp Ser Gly Gly Pro Leu Ala Val Asp Ser  
225 230 235 240

Asn Asn Glu Lys Ile Leu Ile Gly Val Thr Ser Tyr Gly Ala Gln Ala  
245 250 255

Gly Cys Ala Val Gly Leu Pro Ala Ala Phe Ala Arg Val Thr Ser Phe  
260 265 270

Val Ser Trp Val Gln Ser Gln  
275

<210> 49  
<211> 292  
<212> PRT  
<213> Helicoverpa punctigera

<400> 49

Met Lys Leu Phe Leu Gly Val Cys Leu Ala Leu Ala Val Ala Val Ser  
1 5 10 15

Ala Val Glu Ile Gly Thr Pro Glu Ala Gly Ser Pro Val Phe Gly Tyr  
20 25 30

His Ala Lys Phe Gly Ile Ala Glu Ala Ala Arg Ile Lys Ser Ala Glu  
35 40 45

Glu Val Gln Ser Phe Asn Gly Gln Arg Ile Val Gly Gly Ser Ile Thr  
50 55 60

Asn Ile Ala Asn Val Pro Tyr Gln Ala Gly Leu Val Ile Thr Ile Phe  
65 70 75 80

Ile Phe Gln Ser Val Cys Gly Ala Ser Leu Ile Ser His Asn Arg Leu  
85 90 95

Val Thr Ala Ala His Cys Lys Phe Asp Gly Val Met Thr Ala Asn Ser  
100 105 110

Phe Thr Val Val Leu Gly Ser Asn Thr Leu Phe Phe Gly Gly Thr Arg  
115 120 125

Ile Asn Thr Asn Asp Val Val Met His Pro Asn Trp Asn Pro Ser Thr  
130 135 140

Val Ala Asn Asp Ile Ala Val Ile Arg Ile Ser Ser Ile Val Tyr Asn  
145 150 155 160

Asn Val Ile Gln Pro Ile Ala Leu Pro Ser Gly Asp Glu Leu Asp Asn  
165 170 175

Leu Phe Val Gly Ala Asn Ala Leu Ala Ser Gly Phe Gly Arg Thr Ser  
180 185 190

Asp Ser Gly Gly Ile Gly Thr Asn Gln Gln Leu Ser Ser Val Thr Ile  
195 200 205

Pro Val Ile Thr Asn Ala Glu Cys Ala Ala Val Tyr Gly Pro Ala Phe  
210 215 220

Val His Asp Thr Asn Ile Cys Thr Ser Gly Ala Gly Gly Lys Gly Thr  
225 230 235 240

Cys Asn Gly Asp Ser Gly Gly Pro Leu Ala Val Asp Ser Asn Asp Lys  
245 250 255

Lys Ile Leu Ile Gly Val Thr Ser Tyr Gly Ala Ala Asp Gly Cys Ala  
260 265 270

Ala Gly Phe Pro Ala Ala Phe Ala Arg Val Thr Ser Phe Val Ser Trp  
275 280 285

Val Gln Ser Gln  
290

<210> 50  
<211> 295  
<212> PRT  
<213> Helicoverpa punctigera

<400> 50

Met Lys Leu Leu Ala Val Thr Leu Leu Ala Phe Ala Ala Val Val Ser  
1 5 10 15

Ala Arg Asn Ile Asp Leu Glu Asp Val Ile Asp Leu Glu Asp Ile Thr  
20 25 30

Ala Tyr Asp Tyr His Thr Lys Ile Gly Ile Pro Leu Ala Glu Glu Ile  
35 40 45

Arg Ala Ala Glu Glu Glu Ala Glu Arg Asp Pro Ser Arg Ile Val Gly  
50 55 60

Gly Ser Thr Ser Ser Leu Gly Ala Phe Pro Tyr Gln Ala Gly Leu Leu  
65 70 75 80

Ala Asn Phe Ala Ser Gly Gln Gly Val Cys Gly Gly Ser Leu Leu Asn  
85 90 95

Gln Arg Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp Gly Arg Asn  
100 105 110

Gln Ala Arg Ser Phe Thr Val Val Leu Gly Ser Val Arg Leu Phe Ser  
115 120 125

Gly Gly Thr Arg Leu Asp Thr Ala Ser Val Val Met His Gly Ser Trp  
130 135 140

Asn Pro Asn Leu Ile Arg Asn Asp Ile Ala Met Ile Asn Leu Pro Ser  
145 150 155 160

Asn Val Ala Thr Ser Gly Asn Ile Ala Pro Ile Ala Leu Pro Ser Gly  
165 170 175

Asn Glu Leu Asn Asn Asn Phe Asn Gly Ala Thr Ala Thr Ala Ser Gly  
180 185 190

Phe Gly Leu Ala Arg Asp Gly Gly Ser Val Asp Gly Asn Leu Arg His  
195 200 205

Val Asn Leu Pro Val Ile Thr Asn Ala Val Cys Thr Val Ser Phe Pro  
210 215 220

Gly Ile Ile Gln Ser Ser Asn Ile Cys Thr Ser Gly Ala Asn Gly Arg  
225 230 235 240

Ser Thr Cys Gln Gly Asp Ser Gly Gly Pro Leu Val Val Asn Ser Asn  
245 250 255

Asn Arg Arg Ile Leu Ile Gly Val Thr Ser Phe Gly Ser Ala Arg Gly  
260 265 270

Cys Gln Val Gly Ser Pro Ala Ala Phe Ala Arg Val Thr Ser Phe Ile  
275 280 285

Ser Trp Ile Asn Gln Arg Leu  
290 295

<210> 51  
<211> 295  
<212> PRT  
<213> Helicoverpa punctigera

<400> 51

Met Lys Leu Leu Ala Val Thr Leu Leu Ala Phe Ala Ala Val Val Ser  
1 5 10 15

Ala Arg Asn Ile Asp Leu Glu Asp Val Ile Asp Leu Glu Asp Ile Thr  
20 25 30

Ala Tyr Asp Tyr His Thr Lys Ile Gly Ile Pro Leu Ala Glu Lys Ile  
35 40 45

Arg Ala Ala Glu Glu Glu Ala Glu Arg Asn Pro Ser Arg Ile Val Gly  
50 55 60

Gly Ser Thr Ser Ser Leu Gly Ala Phe Pro Tyr Gln Ala Gly Leu Leu  
65 70 75 80

Ala Ser Phe Ala Ser Gly Gln Gly Val Cys Gly Gly Ser Leu Leu Asn  
85 90 95

Val	Arg	Arg	Val	Leu	Thr	Ala	Ala	His	Cys	Trp	Phe	Asp	Gly	Arg	Asn	100	105	110	
Gln	Ala	Arg	Ser	Phe	Thr	Val	Val	Leu	Gly	Ser	Val	Arg	Leu	Tyr	Ser	115	120	125	
Gly	Gly	Thr	Arg	Leu	Asn	Thr	Ala	Ser	Val	Val	Met	His	Gly	Ser	Trp	130	135	140	
Asn	Pro	Asn	Leu	Val	Arg	Asn	Asp	Ile	Ala	Met	Ile	Asn	Leu	Pro	Ser	145	150	155	160
Asn	Val	Ala	Thr	Ser	Gly	Asn	Ile	Ala	Pro	Ile	Ala	Leu	Pro	Ser	Gly	165	170	175	
Asn	Glu	Leu	Asn	Asn	Gln	Phe	Ala	Gly	Ala	Thr	Ala	Thr	Ala	Ser	Gly	180	185	190	
Phe	Gly	Leu	Ala	Arg	Asp	Gly	Gly	Val	Ile	Asp	Gly	Asn	Leu	Arg	His	195	200	205	
Val	Asn	Leu	Pro	Val	Ile	Thr	Asn	Ala	Val	Cys	Ser	Gln	Ser	Phe	Pro	210	215	220	
Gly	Leu	Ile	Gln	Ala	Ser	Asn	Val	Cys	Thr	Ser	Gly	Ala	Asn	Gly	Arg	225	230	235	240
Ser	Thr	Cys	Gln	Gly	Asp	Ser	Gly	Gly	Pro	Leu	Val	Val	Asn	Ser	Asn	245	250	255	
Asn	Arg	Arg	Ile	Leu	Ile	Gly	Val	Thr	Ser	Phe	Gly	Ser	Ala	Arg	Gly	260	265	270	
Cys	Gln	Val	Gly	Ser	Pro	Ala	Ala	Phe	Ala	Arg	Val	Ser	Ser	Tyr	Ile	275	280	285	
Ser	Trp	Ile	Asn	Gln	Arg	Leu										290	295		



<210> 52  
<211> 234  
<212> PRT  
<213> Helicoverpa punctigera

<400> 52

Ile Val Gly Gly Ser Ser Ala Ser Leu Gly Gln Phe Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Leu Ile Asn Leu Pro Leu Gly Gln Ser Val Cys Gly Gly Ser  
20 25 30

Leu Leu Asn Gln Arg Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp  
35 40 45

Gly Arg Asn Gln Ala Thr Ser Leu Thr Val Ile Leu Gly Ser Ile Asn  
50 55 60

Leu Phe Phe Gly Gly Thr Arg Leu Asn Ser Asn Ser Val Val Met Gln  
65 70 75 80

Gly Ser Trp Asn Pro Asn Leu Ile Arg Asn Asp Ile Ala Ile Ile Asn  
85 90 95

Leu Pro Ser Asn Val Gly Thr Ser Gly Asn Ile Ala Pro Ile Ala Leu  
100 105 110

Pro Ser Gly Asn Glu Leu Asn Asn Gln Phe Ala Gly Phe Thr Ala Thr  
115 120 125

Ala Ser Gly Phe Gly Leu Thr Arg Asp Gly Gly Asn Val Ser Pro Thr  
130 135 140

Leu Asn His Val Asn Leu Pro Val Ile Thr Asn Asn Val Cys Trp Gln  
145 150 155 160

Ser Phe Pro Leu Tyr Ile Gln Ser Thr Asn Ile Cys Thr Ser Gly Ala  
165 170 175

Asn Gly Arg Gly Thr Cys Gln Gly Asp Ser Gly Gly Pro Leu Val Val  
180 185 190

Thr Ser Asn Asn Arg Arg Ile Leu Ile Gly Val Thr Ser Phe Gly Ser  
195 200 205

Asp Arg Gly Cys Gln Val Gly Ala Pro Ala Ala Phe Ala Arg Val Thr  
210 215 220

Ser Tyr Ile Ser Trp Ile Asn Gln Arg Leu  
225 230

<210> 53  
<211> 296  
<212> PRT  
<213> Helicoverpa punctigera

<400> 53

Met Ala Ala Ala Tyr Leu Leu Gly Leu Leu Phe Val Leu Gly Tyr Val  
1 5 10 15

Gln Gly Gly Leu Leu Asn Ala Asp Pro Ala Ile Ile Glu Asp Leu Arg  
20 25 30

Asp Ala Glu Phe Ser Ser Gly Ser Arg Ile Val Ala Gly Trp Pro Ala  
35 40 45

Val Glu Gly Gln Ile Pro Tyr Gln Gly Ser Leu Arg Met Val Ser Ala  
50 55 60

Ile Gly Gly Val Ser Ser Cys Gly Cys Ser Leu Ile His Asn Lys Trp  
65 70 75 80

Val Leu Thr Ala Ala His Cys Leu Ala Asn Arg Ile Thr Phe Val Val  
85 90 95

Arg Phe Gly Leu Thr Asn Leu Thr Arg Pro Glu Ile Leu Val Glu Ser  
100 105 110

Thr Asn Lys Tyr Ile His Pro Glu Tyr Asp Glu Ile Arg Ala Gly Val  
115 120 125

Gln Thr Ala Asp Leu Ala Leu Val Gly Leu Asp His Glu Ile Glu Tyr  
130 135 140

Ser Ala Asn Val Gln Pro Ser Arg Leu Met Ser Ser Ala Gln Lys Asn  
145 150 155 160

Ile Asn Tyr Glu Gly Ile Gln Met Ile Val Ser Gly Phe Gly Arg Thr  
165 170 175

Asp Asp Leu Trp Asn Gly Gly Ala Ala Ser Glu Ile Leu Leu Trp Val  
180 185 190

Tyr Gln Arg Gly Val Ser Asn Glu Glu Cys Leu Arg Trp Tyr Pro Thr  
195 200 205

Ser Gln Val Ile Lys Glu Gln Thr Ile Cys Ala Gly Tyr Trp Asp Asn  
210 215 220

Pro Ser Gln Ser Ser Cys Gln Gly Asp Ser Gly Gly Pro Leu Thr Ile  
225 230 235 240

Ile Asp Ala Asp Gly Glu Arg Thr Gln Ser Arg Tyr Cys Glu Leu Arg  
245 250 255

Ile His Cys Trp Asn Ala Ala His Ser Pro Gln Gly Tyr Val Arg Pro  
260 265 270

Gly His Tyr His Asp Trp Phe Thr Glu Val Thr Gly Ile Asn Phe Asp  
275 280 285

Trp Asp Ser Asp Ala Ile Ile Pro  
290 295

<210> 54  
<211> 365  
<212> PRT  
<213> Helicoverpa punctigera

<400> 54

Met Ala Ala Ala Tyr Leu Leu Gly Leu Leu Phe Val Leu Gly Tyr Val  
1 5 10 15

Gln Gly Gly Leu Leu Asn Ala Asp Pro Ala Ile Ile Glu Asp Leu Arg  
20 25 30

Asp Ala Glu Phe Ser Ser Phe Ser Arg Ile Val Ala Gly Trp Pro Ala  
35 40 45

Val Glu Gly Gln Ile Pro Tyr Gln Gly Ser Leu Arg Met Val Ser Ala  
50 55 60

Ile Gly Gly Val Ser Ser Cys Gly Cys Ser Leu Ile His Asn Lys Trp  
65 70 75 80

Val Leu Thr Ala Ala His Cys Leu Ala Asn Arg Ile Thr Phe Val Val  
85 90 95

Arg Phe Gly Leu Thr Asn Leu Thr Arg Pro Glu Ile Leu Val Glu Ser  
100 105 110

Thr Asn Lys Tyr Ile His Pro Glu Tyr Asp Glu Ile Arg Ala Gly Val  
115 120 125

Gln Thr Ala Asp Leu Ala Leu Val Gly Leu Asp Gln Glu Ile Glu Tyr  
130 135 140

Ser Ala Asn Val Gln Pro Ser Arg Leu Met Ser Ser Ala Gln Lys Asn  
145 150 155 160

Ile Asn Tyr Glu Gly Ile Gln Met Ile Val Ser Gly Phe Gly Arg Thr  
165 170 175

Asp Asp Leu Trp Asn Gly Gly Ala Ala Ser Glu Ile Leu Leu Trp Val  
180 185 190

Tyr Gln Arg Gly Val Ser Asn Glu Glu Cys Leu Arg Trp Tyr Pro Thr  
195 200 205

Ser Gln Val Ile Lys Glu Gln Thr Ile Cys Ala Gly Tyr Trp Asp Asn  
210 215 220

Pro Ser Gln Ser Ser Cys Gln Gly Asp Ser Gly Gly Pro Leu Thr Ile  
225 230 235 240

Ile Asp Ala Asp Gly Glu Arg Thr Gln Val Gly Ile Val Ser Ser Asp  
245 250 255

Pro Leu Leu Asp Ala Thr Val His Ser Pro Arg Val Thr Ser Pro Gly  
260 265 270

His Tyr His Asp Gly His Arg Gly Asp Arg His Gln Leu Arg Leu Gly  
275 280 285

Gln Arg Arg His Tyr Pro Asp Ser Ser Glu Ser Ser Leu Arg Ala Ala  
290 295 300

Ile Leu Pro Leu Glu Ser Ser Arg Ala Phe Ile Arg Arg Asn Gln Ser  
305 310 315 320

Ser Phe Arg Gly Gly Leu Cys Gln Pro Pro Arg Phe Pro Thr Arg Thr  
325 330 335

Val Pro Thr His Leu Pro Arg Arg Thr Leu Ala Ala Pro Pro Ser Glu  
340 345 350

Glu Glu Glu Ala Pro Glu Lys Val Arg Val Val Glu Tyr  
355 360 365

<210> 55  
<211> 36  
<212> PRT  
<213> Helicoverpa punctigera

<400> 55

Ile Val Gly Gly Ser Leu Ser Ser Val Gly Gln Ile Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Val Ile Asp Leu Ala Gly Gly Gln Ala Val Cys Gly Gly Ser  
20 25 30

Leu Ile Ser Ala  
35

<210> 56  
<211> 30  
<212> PRT  
<213> Helicoverpa punctigera

<400> 56

Ile Val Gly Gly Ser Thr Ser Ser Val Gly Gln Phe Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Leu Ala Ser Phe Ala Gly Gly Gln Ala Val Cys Gly  
20 25 30

<210> 57  
<211> 37  
<212> PRT  
<213> Helicoverpa punctigera

<400> 57

Ile Val Gly Gly Ser Ile Thr Asp Ile Ala Asn Val Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Val Ile Thr Ile Phe Ile Phe Gln Ser Val Cys Gly Ala Ser  
20 25 30

Leu Ile Ser His Asn  
35

<210> 58  
<211> 37  
<212> PRT  
<213> Helicoverpa punctigera

<400> 58

Ile Val Gly Gly Ser Ile Thr Asn Ile Ala Asn Val Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Val Ile Thr Ile Phe Ile Phe Gln Ser Val Cys Gly Ala Ser  
20 25 30

Leu Ile Ser His Asn  
35

<210> 59  
<211> 37  
<212> PRT  
<213> Helicoverpa punctigera

<400> 59

Ile Val Gly Gly Ser Thr Ser Ser Leu Gly Ala Phe Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Leu Ala Ser Phe Ala Ser Gly Gln Gly Val Cys Gly Gly Ser  
20 25 30

Leu Leu Asn Val Arg  
35

<210> 60  
<211> 37  
<212> PRT  
<213> Helicoverpa punctigera

<400> 60

Ile Val Gly Gly Ser Thr Ser Ser Leu Gly Ala Phe Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Leu Ala Asn Phe Ala Ser Gly Gln Gly Val Cys Gly Gly Ser  
20 25 30

Leu Leu Asn Gln Arg  
35

<210> 61  
<211> 37  
<212> PRT  
<213> Helicoverpa punctigera

<400> 61

Ile Val Gly Gly Ser Ser Ala Ser Leu Gly Gln Phe Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Ser Leu Ile Tyr Ser Gly Gln Ser Val Cys Gly Gly Ser Leu  
20 25 30

Leu Asn Gln Arg Arg  
35

<210> 62  
<211> 37  
<212> PRT  
<213> Helicoverpa punctigera

<400> 62

Ile Val Ala Gly Trp Pro Ala Val Glu Gly Gln Ile Pro Tyr Gln Gly  
1 5 10 15

Ser Leu Arg Met Val Ser Ala Ile Gly Gly Val Ser Ser Cys Gly Cys  
20 25 30

Ser Leu Ile His Asn  
35

<210> 63  
<211> 235  
<212> PRT  
<213> Helicoverpa punctigera

<400> 63

Ile Val Gly Gly Ser Ile Thr Asp Ile Ala Asn Val Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Val Ile Thr Ile Phe Ile Phe Gln Ser Val Cys Gly Ala Ser  
20 25 30

Leu Ile Ser His Asn Arg Leu Val Thr Ala Ala His Cys Lys Ser Asp  
35 40 45

Gly Val Leu Thr Ala Asn Ser Phe Thr Val Val Leu Gly Ser Asn Thr  
50 55 60

Leu Phe Phe Gly Gly Thr Arg Ile Asn Thr Asn Asp Val Val Met His  
65 70 75 80

Pro Asn Trp Asn Pro Ser Thr Ala Ala Asn Asp Ile Ala Val Met Arg  
85 90 95

Ile Ser Ser Val Ser Phe Ser Asn Val Ile Gln Pro Ile Ala Leu Pro  
100 105 110

Ser Gly Asp Glu Leu Asn Asn Leu Phe Val Gly Ala Asn Ala Leu Ala  
115 120 125

Phe Gly Phe Gly Arg Thr Ser Asp Gly Gly Ser Ile Gly Ser Asn Gln  
130 135 140

Gln Val Ser Ser Val Thr Ile Pro Val Ile Thr Asn Asp Glu Cys Ala  
145 150 155 160

Ala Val Tyr Gly Ser Ala Phe Val His Ser Ser Asn Ile Cys Thr Ser  
165 170 175

Gly Ala Gly Gly Lys Gly Thr Cys Asn Gly Asp Ser Gly Gly Pro Leu  
180 185 190

Ala Ile Asp Ser Asn Asn Glu Lys Ile Leu Ile Gly Val Thr Ser Tyr  
195 200 205



Gly Ala Gln Ala Gly Cys Ala Ala Gly Leu Pro Ala Ala Phe Ala Arg  
210 215 220

Val Thr Ser Phe Val Ser Trp Val Gln Ser Gln  
225 230 235

<210> 64  
<211> 235  
<212> PRT  
<213> Helicoverpa punctigera

<400> 64

Ile Val Gly Gly Ser Ile Thr Asn Ile Ala Asn Val Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Val Ile Thr Ile Phe Ile Phe Gln Ser Val Cys Gly Ala Ser  
20 25 30

Leu Ile Ser His Asn Arg Leu Val Thr Ala Ala His Cys Lys Phe Asp  
35 40 45

Gly Val Met Thr Ala Asn Ser Phe Thr Val Val Leu Gly Ser Asn Thr  
50 55 60

Leu Phe Phe Gly Gly Thr Arg Ile Asn Thr Asn Asp Val Val Met His  
65 70 75 80

Pro Asn Trp Asn Pro Ser Thr Val Ala Asn Asp Ile Ala Val Ile Arg  
85 90 95

Ile Ser Ser Ile Val Tyr Asn Asn Val Ile Gln Pro Ile Ala Leu Pro  
100 105 110

Ser Gly Asp Glu Leu Asp Asn Leu Phe Val Gly Ala Asn Ala Leu Ala  
115 120 125

Ser Gly Phe Gly Arg Thr Ser Asp Ser Gly Gly Ile Gly Thr Asn Gln  
130 135 140

Gln Leu Ser Ser Val Thr Ile Pro Val Ile Thr Asn Ala Glu Cys Ala  
145 150 155 160

Ala Val Tyr Gly Pro Ala Phe Val His Asp Thr Asn Ile Cys Thr Ser  
165 170 175

Gly Ala Gly Gly Lys Gly Thr Cys Asn Gly Asp Ser Gly Gly Pro Leu  
180 185 190

Ala Val Asp Ser Asn Asp Lys Lys Ile Leu Ile Gly Val Thr Ser Tyr  
195 200 205

Gly Ala Ala Asp Gly Cys Ala Ala Gly Phe Pro Ala Ala Phe Ala Arg  
210 215 220

Val Thr Ser Phe Val Ser Trp Val Gln Ser Gln  
225 230 235

<210> 65  
<211> 234  
<212> PRT  
<213> Helicoverpa punctigera

<400> 65

Ile Val Gly Gly Ser Thr Ser Ser Leu Gly Ala Phe Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Leu Ala Ser Phe Ala Ser Gly Gln Gly Val Cys Gly Gly Ser  
20 25 30

Leu Leu Asn Val Arg Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp  
35 40 45

Gly Arg Asn Gln Ala Arg Ser Phe Thr Val Val Leu Gly Ser Val Arg  
50 55 60

Leu Tyr Ser Gly Gly Thr Arg Leu Asn Thr Ala Ser Val Val Met His  
65 70 75 80

Gly Ser Trp Asn Pro Asn Leu Val Arg Asn Asp Ile Ala Met Ile Asn  
85 90 95

Leu Pro Ser Asn Val Ala Thr Ser Gly Asn Ile Ala Pro Ile Ala Leu  
100 105 110

Pro Ser Gly Asn Glu Leu Asn Asn Gln Phe Ala Gly Ala Thr Ala Thr  
115 120 125

Ala Ser Gly Phe Gly Leu Ala Arg Asp Gly Gly Val Ile Asp Gly Asn  
130 135 140

Leu Arg His Val Asn Leu Pro Val Ile Thr Asn Ala Val Cys Ser Gln  
145 150 155 160

Ser Phe Pro Gly Leu Ile Gln Ala Ser Asn Val Cys Thr Ser Gly Ala  
165 170 175

Asn Gly Arg Ser Thr Cys Gln Gly Asp Ser Gly Gly Pro Leu Val Val  
180 185 190

Asn Ser Asn Asn Arg Arg Ile Leu Ile Gly Val Thr Ser Phe Gly Ser  
195 200 205

Ala Arg Gly Cys Gln Val Gly Ser Pro Ala Ala Phe Ala Arg Val Ser  
210 215 220

Ser Tyr Ile Ser Trp Ile Asn Gln Arg Leu  
225 230

<210> 66  
<211> 234  
<212> PRT  
<213> Helicoverpa punctigera

<400> 66

Ile Val Gly Gly Ser Thr Ser Ser Leu Gly Ala Phe Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Leu Ala Asn Phe Ala Ser Gly Gln Gly Val Cys Gly Gly Ser  
20 25 30

Leu Leu Asn Gln Arg Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp  
35 40 45

Gly Arg Asn Gln Ala Arg Ser Phe Thr Val Val Leu Gly Ser Val Arg  
50 55 60

Leu Phe Ser Gly Gly Thr Arg Leu Asp Thr Ala Ser Val Val Met His  
65 70 75 80

Gly Ser Trp Asn Pro Asn Leu Ile Arg Asn Asp Ile Ala Met Ile Asn  
85 90 95

Leu Pro Ser Asn Val Ala Thr Ser Gly Asn Ile Ala Pro Ile Ala Leu  
100 105 110

Pro Ser Gly Asn Glu Leu Asn Asn Asn Phe Asn Gly Ala Thr Ala Thr  
115 120 125

Ala Ser Gly Phe Gly Leu Ala Arg Asp Gly Gly Ser Val Asp Gly Asn  
130 135 140

Leu Arg His Val Asn Leu Pro Val Ile Thr Asn Ala Val Cys Thr Val  
145 150 155 160

Ser Phe Pro Gly Ile Ile Gln Ser Ser Asn Ile Cys Thr Ser Gly Ala  
165 170 175

Asn Gly Arg Ser Thr Cys Gln Gly Asp Ser Gly Gly Pro Leu Val Val  
180 185 190

Asn Ser Asn Asn Arg Arg Ile Leu Ile Gly Val Thr Ser Phe Gly Ser  
195 200 205

Ala Arg Gly Cys Gln Val Gly Ser Pro Ala Ala Phe Ala Arg Val Thr  
210 215 220

Ser Phe Ile Ser Trp Ile Asn Gln Arg Leu  
225 230

<210> 67  
<211> 282  
<212> PRT  
<213> Helicoverpa punctigera

<400> 67

Ile Val Gly Gly Ser Ser Ala Ser Leu Gly Gln Phe Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Ser Leu Ile Tyr Ser Gly Gln Ser Val Cys Gly Gly Ser Leu  
20 25 30

Leu Asn Gln Arg Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp Gly  
35 40 45

Ile Val Ala Gly Trp Pro Ala Val Glu Gly Gln Ile Pro Tyr Gln Gly  
50 55 60

Ser Leu Arg Met Val Ser Ala Ile Gly Gly Val Ser Ser Cys Gly Cys  
65 70 75 80

Ser Leu Ile His Asn Lys Trp Val Leu Thr Ala Ala His Cys Leu Ala  
85 90 95

Asn Arg Asn Gln Ala Thr Ser Leu Thr Val Ile Leu Gly Ser Ile Asn  
100 105 110

Leu Phe Phe Gly Gly Thr Arg Leu Asn Ser Asn Ser Val Val Met His  
115 120 125

Gly Ser Trp Asn Pro Asn Leu Ile Arg Asn Asp Ile Ala Ile Ile Asn  
130 135 140

Leu Pro Ser Asn Val Gly Thr Ser Gly Asn Ile Ala Pro Ile Ala Leu  
145 150 155 160

Pro Ser Gly Asn Glu Leu Asn Asn Gln Phe Ala Gly Phe Thr Ala Thr  
165 170 175

Ala Ser Gly Phe Gly Leu Thr Arg Asp Gly Gly Asn Val Ser Pro Thr  
180 185 190

Leu Asn His Val Asn Leu Pro Val Ile Thr Asn Asn Val Cys Trp Gln  
195 200 205

Ser Phe Pro Leu Tyr Ile Gln Ser Thr Asn Ile Cys Thr Ser Gly Ala  
210 215 220

Asn Gly Arg Gly Thr Cys Gln Gly Asp Ser Gly Gly Pro Leu Val Val  
225 230 235 240

Thr Ser Asn Asn Arg Arg Ile Leu Ile Gly Val Thr Ser Phe Gly Ser  
245 250 255

Asp Arg Gly Cys Gln Val Gly Ala Pro Ala Ala Phe Ala Arg Val Thr  
260 265 270

Ser Tyr Ile Ser Trp Ile Asn Gln Arg Leu  
275 280

<210> 68  
<211> 256  
<212> PRT  
<213> Helicoverpa punctigera

<400> 68

Ile Val Ala Gly Trp Pro Ala Val Glu Gly Gln Ile Pro Tyr Gln Gly  
1 5 10 15

Ser Leu Arg Met Val Ser Ala Ile Gly Gly Val Ser Ser Cys Gly Cys  
20 25 30

Ser Leu Ile His Asn Lys Trp Val Leu Thr Ala Ala His Cys Leu Ala  
35 40 45

Asn Arg Ile Thr Phe Val Val Arg Phe Gly Leu Thr Asn Leu Thr Arg  
50 55 60

Pro Glu Ile Leu Val Glu Ser Thr Asn Lys Tyr Ile His Pro Glu Tyr  
65 70 75 80

Asp Glu Ile Arg Ala Gly Val Gln Thr Ala Asp Leu Ala Leu Val Gly  
85 90 95

Leu Asp His Glu Ile Glu Tyr Ser Ala Asn Val Gln Pro Ser Arg Leu  
100 105 110

Met Ser Ser Ala Gln Lys Asn Ile Asn Tyr Glu Gly Ile Gln Met Ile  
115 120 125

Val Ser Gly Phe Gly Arg Thr Asp Asp Leu Trp Asn Gly Gly Ala Ala  
130 135 140

Ser Glu Ile Leu Leu Trp Val Tyr Gln Arg Gly Val Ser Asn Glu Glu  
145 150 155 160

Cys Leu Arg Trp Tyr Pro Thr Ser Gln Val Ile Lys Glu Gln Thr Ile  
165 170 175

Cys Ala Gly Tyr Trp Asp Asn Pro Ser Gln Ser Ser Cys Gln Gly Asp  
180 185 190

Ser Gly Gly Pro Leu Thr Ile Ile Asp Ala Asp Gly Glu Arg Thr Gln  
195 200 205

Ser Arg Tyr Cys Glu Leu Arg Ile His Cys Trp Asn Ala Thr Ala His  
210 215 220

Ser Pro Gln Gly Tyr Val Arg Pro Gly His Tyr His Asp Trp Phe Thr  
225 230 235 240

Glu Val Thr Gly Ile Asn Phe Asp Trp Asp Ser Asp Ala Ile Ile Pro  
245 250 255

<210> 69  
<211> 236  
<212> PRT  
<213> Helicoverpa punctigera

<400> 69

Ile Val Gly Gly Ser Leu Ser Ser Val Gly Gln Ile Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Val Ile Asp Leu Ala Gly Gly Gln Ala Val Cys Gly Gly Ser  
20 25 30

Leu Ile Ser Ala Ser Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp  
35 40 45

Gly Gln Asn Gln Ala Trp Arg Phe Thr Val Val Leu Gly Ser Thr Thr  
50 55 60

Leu Phe Ser Gly Gly Thr Arg Ile Pro Thr Ser Asn Val Val Met His  
65 70 75 80

Gly Ser Trp Thr Pro Ser Leu Ile Arg Asn Asp Val Ala Val Ile Arg  
85 90 95

Leu Gly Thr Asn Val Ala Thr Ser Asn Thr Ile Ala Ile Ile Ala Leu  
100 105 110

Pro Ser Gly Ser Gln Ile Asn Glu Asn Phe Ala Gly Glu Thr Ala Leu  
115 120 125

Ala Ser Gly Phe Gly Leu Thr Ser Asp Thr Gly Ser Ile Ser Ser Asn  
130 135 140

Gln Ala Leu Ser His Val Asn Leu Pro Val Ile Thr Asn Ala Val Cys  
145 150 155 160

Arg Asn Ser Phe Pro Leu Leu Ile Gln Asp Ser Asn Ile Cys Thr Ser  
165 170 175

Gly Ala Asn Gly Arg Ser Thr Cys Arg Gly Asp Ser Gly Gly Pro Leu  
180 185 190

Val Val Thr Arg Asn Asn Arg Pro Leu Leu Ile Gly Ile Thr Ser Phe  
195 200 205

Gly Ser Ala Arg Gly Cys Gln Val Gly Ser Pro Ala Ala Phe Ala Arg  
210 215 220

Val Thr Ser Tyr Ile Ser Trp Ile Asn Gly Gln Leu  
225 230 235

<210> 70  
<211> 224  
<212> PRT  
<213> Homo sapiens

<400> 70

Ile Val Gly Gly Tyr Thr Cys Glu Glu Asn Ser Leu Pro Tyr Gln Val  
1 5 10 15

Ser Leu Asn Ser Gly Ser His Phe Cys Gly Gly Ser Leu Ile Ser Glu  
20 25 30

Gln Trp Val Val Ser Ala Ala His Cys Tyr Lys Thr Arg Ile Gln Val  
35 40 45

Arg Leu Gly Glu His Asn Ile Lys Val Leu Glu Gly Asn Glu Gln Phe  
50 55 60

Ile Asn Ala Ala Lys Ile Ile Arg His Pro Lys Tyr Asn Arg Asp Thr  
65 70 75 80



Leu Asp Asn Asp Ile Met Leu Ile Lys Leu Ser Ser Pro Ala Val Ile  
85 90 95

Asn Ala Arg Val Ser Thr Ile Ser Leu Pro Thr Ala Pro Pro Ala Ala  
100 105 110

Gly Thr Glu Cys Leu Ile Ser Gly Trp Gly Asn Thr Leu Ser Phe Gly  
115 120 125

Ala Asp Tyr Pro Asp Glu Leu Lys Cys Leu Asp Ala Pro Val Leu Thr  
130 135 140

Gln Ala Glu Cys Lys Ala Ser Tyr Pro Gly Lys Ile Thr Asn Ser Met  
145 150 155 160

Phe Cys Val Gly Phe Leu Glu Gly Gly Lys Asp Ser Cys Gln Arg Asp  
165 170 175

Ser Gly Gly Pro Val Val Cys Asn Gly Gln Leu Gln Gly Val Val Ser  
180 185 190

Trp Gly His Gly Cys Ala Trp Lys Asn Arg Pro Gly Val Tyr Thr Lys  
195 200 205

Val Tyr Asn Tyr Val Asp Trp Ile Lys Asp Thr Ile Ala Ala Asn Ser  
210 215 220

<210> 71

<211> 275

<212> PRT

<213> Helicoverpa armigera

<400> 71

Val His Leu Glu Asp Ser Ile Asp Leu Glu Asp Ile Thr Ala Trp Gly  
1 5 10 15

Tyr Leu Thr Lys Phe Gly Ile Pro Glu Ala Glu Lys Ile Arg Asn Ala  
20 25 30

Glu Glu Ala Ser Ser Ala Ser Arg Ile Val Gly Gly Ser Leu Ser Ser  
35 40 45

Leu Gly Gln Ile Pro Tyr Gln Ala Gly Leu Val Ile Asp Leu Ser Gly  
50 55 60

Gly Gln Ala Val Cys Gly Gly Ser Leu Ile Ser Ala Ser Arg Val Leu  
65 70 75 80

Thr Ala Ala His Cys Trp Phe Asp Gly Gln Asn Gln Ala Trp Arg Phe  
85 90 95

Thr Val Val Leu Gly Ser Thr Thr Leu Phe Ser Gly Gly Thr Arg Ile  
100 105 110

Ala Thr Ser Asn Val Val Met His Gly Ser Trp Thr Pro Ser Leu Ile  
115 120 125

Arg Asn Asp Val Ala Val Ile Arg Leu Gly Thr Asn Val Gly Thr Ser  
130 135 140

Asn Thr Ile Ala Ile Ile Ala Leu Pro Ser Gly Ser Gln Ile Asn Glu  
145 150 155 160

Asn Phe Ala Gly Glu Thr Ala Leu Ala Ser Gly Phe Gly Leu Thr Ser  
165 170 175

Asp Ser Gly Ser Ile Ser Ser Asn Gln Ala Leu Ser His Val Asn Leu  
180 185 190

Pro Val Ile Thr Asn Ala Val Cys Arg Ser Ser Phe Pro Leu Leu Ile  
195 200 205

Gln Asp Ser Asn Ile Cys Thr Ser Gly Ala Asn Gly Arg Ser Thr Cys  
210 215 220

Arg Gly Asp Ser Gly Gly Pro Leu Val Val Thr Arg Asn Ser Arg Pro  
225 230 235 240

Leu Leu Ile Gly Ile Thr Ser Phe Gly Ser Ala Arg Gly Cys Gln Val  
245 250 255

Gly Ser Pro Ala Ala Phe Ala Arg Val Thr Ser Tyr Ile Ser Trp Ile  
260 265 270

Asn Gly Gln  
275

<210> 72  
<211> 275  
<212> PRT  
<213> Helicoverpa punctigera

<400> 72

Val His Leu Glu Asp Ser Ile Asp Leu Glu Asp Ile Thr Ala Trp Gly  
1 5 10 15

Tyr Leu Thr Lys Phe Gly Ile Pro Glu Ala Glu Lys Ile Arg Asn Ala  
20 25 30

Glu Glu Ala Ser Ser Ala Ser Arg Ile Val Gly Gly Ser Leu Ser Ser  
35 40 45

Leu Gly Gln Ile Pro Tyr Gln Ala Gly Leu Val Ile Asp Leu Ala Gly  
50 55 60

Gly Gln Ala Val Cys Gly Gly Ser Leu Ile Ser Ala Ser Arg Val Leu  
65 70 75 80

Thr Ala Ala His Cys Trp Phe Asp Gly Gln Asn Gln Ala Trp Arg Phe  
85 90 95

Thr Val Val Leu Gly Ser Thr Thr Leu Phe Ser Gly Gly Thr Arg Ile  
100 105 110

Pro Thr Ser Asn Val Val Met His Gly Ser Trp Thr Pro Ser Leu Ile  
115 120 125

Arg Asn Asp Val Ala Val Ile Arg Leu Gly Thr Asn Val Gly Thr Ser  
130 135 140

Asn Thr Ile Ala Ile Ile Ala Leu Pro Ser Gly Ser Gln Ile Asn Glu  
145 150 155 160

Asn Phe Ala Gly Glu Thr Ala Leu Ala Ser Gly Phe Gly Leu Thr Ser  
165 170 175

Asp Thr Gly Ser Ile Ser Ser Asn Gln Ala Leu Ser His Val Asn Leu  
180 185 190

Pro Val Ile Thr Asn Ala Val Cys Arg Asn Ser Phe Pro Leu Leu Ile  
195 200 205

Gln Asp Ser Asn Ile Cys Thr Ser Gly Ala Asn Gly Arg Ser Thr Cys  
210 215 220

Arg Gly Asp Ser Gly Gly Pro Leu Val Val Thr Arg Asn Asn Arg Pro  
225 230 235 240

Leu Leu Ile Gly Ile Thr Ser Phe Gly Ser Ala Arg Gly Cys Gln Val  
245 250 255

Gly Ser Pro Ala Ala Phe Ala Arg Val Thr Ser Tyr Ile Ser Trp Ile  
260 265 270

Asn Gly Gln  
275

<210> 73  
<211> 230  
<212> PRT  
<213> bovine

<400> 73

Ile Val Asn Gly Glu Asp Ala Val Pro Gly Ser Trp Pro Trp Gln Val  
1 5 10 15

Ser Leu Gln Asp Ser Thr Gly Phe His Phe Cys Gly Gly Ser Leu Ile  
20 25 30

Ser Glu Asp Trp Val Val Thr Ala Ala His Cys Gly Val Thr Thr Ser  
35 40 45

Asp Val Val Val Ala Gly Glu Phe Asp Gln Gly Ser Ser Ser Glu Lys  
50 55 60

Ile Gln Lys Leu Lys Ile Ala Lys Val Phe Lys Asn Ser Lys Tyr Asn  
65 70 75 80

Ser Leu Thr Ile Asn Asn Asp Ile Thr Leu Leu Lys Leu Ala Thr Pro  
85 90 95

Ala Gln Phe Ser Glu Thr Val Ser Ala Val Cys Leu Pro Ser Ala Asp  
100 105 110

Glu Asp Phe Pro Ala Gly Met Leu Cys Ala Thr Thr Gly Trp Gly Lys  
115 120 125

Thr Lys Tyr Asn Ala Leu Lys Thr Pro Asp Lys Leu Gln Gln Ala Thr  
130 135 140

Leu Pro Ile Val Ser Asn Thr Asp Cys Arg Lys Tyr Trp Gly Ser Arg  
145 150 155 160

Val Thr Asp Val Met Ile Cys Ala Gly Ala Ser Gly Val Ser Ser Cys  
165 170 175

Met Gly Asp Ser Gly Gly Pro Leu Val Cys Gln Lys Asn Gly Ala Trp  
180 185 190

Thr Leu Ala Gly Ile Val Ser Trp Gly Ser Ser Thr Cys Ser Thr Ser  
195 200 205

Thr Pro Ala Val Tyr Ala Arg Val Thr Ala Leu Met Pro Trp Val Gln  
210 215 220

Glu Thr Leu Ala Ala Asn  
225 230

<210> 74  
<211> 230  
<212> PRT  
<213> bovine

<400> 74

Ile Val Asn Gly Glu Glu Ala Val Pro Gly Ser Trp Pro Trp Gln Val  
1 5 10 15

Ser Leu Gln Asp Lys Thr Gly Phe His Phe Cys Gly Gly Ser Leu Ile  
20 25 30

Asn Glu Asn Trp Val Val Thr Ala Ala His Cys Gly Val Thr Thr Ser  
35 40 45

Asp Val Val Val Ala Gly Glu Phe Asp Gln Gly Leu Glu Thr Glu Asp  
50 55 60

Thr Gln Val Leu Lys Ile Gly Lys Val Phe Lys Asn Pro Lys Phe Ser  
65 70 75 80

Ile Leu Thr Val Arg Asn Asp Ile Thr Leu Leu Lys Leu Ser Thr Ala  
85 90 95

Ala Ser Phe Ser Gln Thr Val Ser Ala Val Cys Leu Pro Ser Ala Ser  
100 105 110

Asp Asp Phe Ala Ala Gly Thr Thr Cys Val Thr Thr Gly Trp Gly Leu  
115 120 125

Thr Arg Tyr Thr Asn Ala Asn Thr Pro Asp Arg Leu Gln Gln Ala Ser  
130 135 140

Leu Pro Leu Leu Ser Asn Thr Asn Cys Lys Lys Tyr Trp Gly Thr Lys  
145 150 155 160

Ile Lys Asp Ala Met Ile Cys Ala Gly Ala Ser Gly Val Ser Ser Cys  
165 170 175

Met Gly Asp Ser Gly Gly Pro Leu Val Cys Lys Gln Asn Gly Ala Trp  
180 185 190

Thr Leu Val Gly Ile Val Ser Trp Gly Ser Ser Thr Cys Ser Thr Ser  
195 200 205

Thr Pro Gly Val Tyr Ala Arg Val Thr Ala Leu Val Asn Trp Val Gln  
210 215 220

Gln Thr Leu Ala Ala Asn  
225 230

<210> 75  
<211> 237  
<212> PRT  
<213> Helicoverpa punctigera

<400> 75

Ile Val Gly Gly Ser Thr Ser Ser Leu Gly Ala Phe Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Leu Ala Ser Phe Ala Ser Gly Gln Gly Val Cys Gly Gly Ser  
20 25 30

Leu	Leu	Asn	Val	Arg	Arg	Val	Leu	Thr	Ala	Ala	His	Cys	Trp	Phe	Asp
		35					40					45			
Gly	Arg	Asn	Gln	Ala	Arg	Ser	Phe	Thr	Val	Val	Leu	Gly	Ser	Val	Arg
	50					55					60				
Leu	Tyr	Ser	Gly	Gly	Thr	Arg	Leu	Asn	Thr	Ala	Ser	Val	Val	Met	His
65					70					75					80
Gly	Ser	Trp	Asn	Pro	Asn	Leu	Val	Arg	Thr	Ile	Asn	Asn	Asp	Ile	Ala
				85					90					95	
Met	Ile	Asn	Leu	Pro	Ser	Asn	Val	Ala	Thr	Ser	Gly	Asn	Ile	Ala	Pro
			100					105					110		
Ile	Ala	Leu	Pro	Ser	Gly	Asn	Glu	Leu	Asn	Asn	Gln	Phe	Ala	Gly	Ala
		115					120					125			
Thr	Ala	Thr	Ala	Ser	Gly	Phe	Gly	Leu	Ala	Arg	Asp	Gly	Gly	Val	Ile
	130					135					140				
Asp	Gly	Asn	Leu	Arg	His	Val	Asn	Leu	Pro	Val	Ile	Thr	Asn	Ala	Val
145					150					155					160
Cys	Ser	Gln	Ser	Phe	Pro	Gly	Leu	Ile	Gln	Ala	Ser	Asn	Val	Cys	Thr
				165					170					175	
Ser	Gly	Ala	Asn	Gly	Arg	Ser	Thr	Cys	Gln	Gly	Gly	Asp	Ser	Gly	Gly
			180					185					190		
Pro	Leu	Val	Asn	Ser	Asn	Asn	Arg	Arg	Ile	Leu	Ile	Gly	Val	Thr	Ser
		195					200					205			
Phe	Gly	Ser	Ala	Arg	Gly	Cys	Gln	Val	Gly	Ser	Pro	Ala	Ala	Phe	Ala
	210					215					220				
Arg	Val	Ser	Ser	Tyr	Ile	Ser	Trp	Ile	Asn	Gln	Arg	Leu			
225					230					235					

<210> 76  
<211> 236  
<212> PRT  
<213> Helicoverpa punctigera

<400> 76

Ile Val Gly Gly Ser Leu Ser Ser Val Gly Gln Ile Pro Tyr Gln Ala  
1 5 10 15

Gly Leu Val Ile Asp Leu Ala Gly Gly Gln Ala Val Cys Gly Gly Ser  
20 25 30

Leu Leu Ser Ala Ser Arg Val Leu Thr Ala Ala His Cys Trp Phe Asp  
35 40 45

Gly Gln Asn Gln Ala Trp Arg Phe Thr Val Val Leu Gly Ser Thr Thr  
50 55 60

Leu Phe Ser Gly Gly Thr Arg Leu Asn Ile Pro Ser Ser Asn Met His  
65 70 75 80

Gly Ser Trp Asn Pro Ser Leu Ile Arg Asn Asp Val Ala Val Ile Arg  
85 90 95

Leu Gly Thr Asn Val Ala Thr Ser Asn Thr Ile Ala Ile Ile Ala Leu  
100 105 110

Pro Ser Gly Ser Gln Ile Asn Glu Asn Phe Ala Gly Glu Thr Ala Leu  
115 120 125

Ala Ser Gly Phe Gly Leu Thr Ser Tyr Thr Gly Ser Ile Ser Ser Asn  
130 135 140

Gln Ala Leu Ser His Val Asn Leu Pro Val Ile Thr Asn Ala Val Cys  
145 150 155 160

Arg Asn Ser Phe Ser Leu Leu Ile Gln Asp Ser Asn Ile Cys Thr Ser  
165 170 175

Gly Ala Asn Gly Arg Ser Thr Cys Arg Gly Asp Ser Gly Gly Pro Leu  
180 185 190

Val Val Thr Arg Asn Asn Arg Pro Leu Leu Ile Gly Val Thr Ser Phe  
195 200 205



Gly Ser Ala Arg Gly Cys Gln Val Gly Ser Pro Ala Ala Phe Ala Arg  
210 215 220

Val Thr Ser Tyr Ile Ser Trp Ile Asn Gly Gln Leu  
225 230 235

<210> 77  
<211> 107  
<212> PRT  
<213> potato

<400> 77

Met Glu Ser Lys Phe Ala His Ile Ile Val Phe Phe Leu Leu Ala Thr  
1 5 10 15

Ser Phe Glu Thr Leu Met Ala Arg Lys Glu Ser Asp Gly Pro Glu Val  
20 25 30

Ile Glu Leu Leu Lys Glu Phe Glu Cys Asn Gly Lys Gln Phe Trp Pro  
35 40 45

Glu Leu Ile Gly Val Pro Thr Lys Leu Ala Lys Glu Ile Ile Glu Lys  
50 55 60

Glu Asn Ser Leu Ile Asn Asn Val Gln Ile Leu Leu Asn Gly Ser Pro  
65 70 75 80

Val Thr Met Asp Tyr Arg Cys Asn Arg Val Arg Leu Phe Asp Asn Ile  
85 90 95

Leu Gly Ser Val Val Gln Ile Pro Arg Val Ala  
100 105

<210> 78  
<211> 107  
<212> PRT  
<213> potato

<400> 78

Met Glu Ser Lys Phe Ala His Ile Ile Val Phe Phe Leu Leu Ala Thr  
1 5 10 15

Ser Phe Glu Thr Leu Leu Ala Arg Lys Glu Ser Asp Gly Pro Glu Val  
20 25 30

Ile Glu Leu Leu Lys Glu Phe Glu Cys Asn Gly Lys Gln Phe Trp Pro  
35 40 45

Glu Leu Ile Gly Val Pro Thr Lys Leu Ala Lys Glu Ile Ile Glu Lys  
50 55 60

Glu Asn Ser Leu Ile Asn Asn Val Gln Ile Leu Leu Asn Gly Ser Pro  
65 70 75 80

Val Ala Met Asp Tyr Arg Cys Asn Arg Val Arg Leu Phe Asp Asn Ile  
85 90 95

Leu Gly Ser Val Val Gln Ile Pro Arg Val Ala  
100 105

<210> 79  
<211> 71  
<212> PRT  
<213> potato

<400> 79

Lys Glu Phe Glu Cys Asp Gly Lys Leu Gln Trp Pro Glu Leu Ile Gly  
1 5 10 15

Val Pro Thr Lys Leu Ala Lys Glu Ile Ile Glu Lys Gln Asn Ser Leu  
20 25 30

Ile Ser Asn Val His Ile Leu Leu Asn Gly Ser Pro Val Thr Met Asp  
35 40 45

Phe Arg Cys Asn Arg Val Arg Leu Phe Asp Asp Ile Leu Gly Ser Val  
50 55 60

Val Gln Ile Pro Arg Val Ala  
65 70

<210> 80  
<211> 106  
<212> PRT  
<213> potato

<400> 80

Met Glu Ser Lys Phe Ala His Ile Ile Val Phe Phe Leu Leu Ala Thr  
1 5 10 15

Ser Phe Glu Thr Leu Leu Ala Arg Lys Glu Ser Asp Gly Pro Glu Val  
20 25 30

Ile Glu Leu Gln Lys Glu Phe Glu Cys Asn Gly Lys Gln Arg Trp Pro  
35 40 45

Glu Leu Ile Gly Val Pro Thr Lys Leu Ala Lys Gly Ile Ile Glu Lys  
50 55 60

Glu Asn Ser Leu Ile Thr Asn Val Gln Ile Leu Leu Asn Gly Ser Pro  
65 70 75 80

Val Thr Met Asp Tyr Arg Ser Asn Arg Val Arg Leu Phe Asp Asn Ile  
85 90 95

Leu Gly Asp Val Val Gln Ile Pro Arg Val  
100 105

<210> 81  
<211> 111  
<212> PRT  
<213> potato

<400> 81

Met Glu Ser Lys Phe Ala His Ile Ile Val Phe Phe Leu Leu Ala Thr  
1 5 10 15

Ser Phe Glu Thr Leu Met Ala Arg Lys Glu Gly Asp Gly Ser Glu Val  
20 25 30

Ile Lys Leu Leu Lys Glu Ser Glu Ser Glu Ser Trp Cys Lys Gly Lys  
35 40 45

Gln Phe Trp Pro Glu Leu Ile Gly Val Pro Thr Lys Leu Ala Lys Glu  
50 55 60

Ile Ile Glu Lys Glu Asn Pro Ser Ile Asn Asp Val Pro Ile Ile Leu  
65 70 75 80

Asn Gly Thr Pro Val Pro Ala Asp Phe Arg Cys Asn Arg Val Arg Leu  
85 90 95

Phe Asp Asn Ile Leu Gly Asp Val Val Gln Ile Pro Arg Val Ala  
100 105 110

<210> 82  
<211> 111  
<212> PRT  
<213> potato

<400> 82

Met Glu Ser Lys Phe Ala His Ile Ile Val Phe Phe Leu Leu Ala Thr  
1 5 10 15

Ser Phe Glu Thr Leu Met Ala Arg Lys Glu Ile Asp Gly Pro Glu Val  
20 25 30

Ile Glu Leu Leu Lys Glu Phe Asp Ser Asn Leu Met Cys Glu Gly Lys  
35 40 45

Gln Met Trp Pro Glu Leu Ile Gly Val Pro Thr Lys Leu Ala Lys Glu  
50 55 60

Ile Ile Glu Lys Glu Asn Pro Ser Ile Thr Asn Ile Pro Ile Leu Leu  
65 70 75 80

Ser Gly Ser Pro Ile Thr Leu Asp Tyr Leu Cys Asp Arg Val Arg Leu  
85 90 95

Phe Asp Asn Ile Leu Gly Phe Val Val Gln Met Pro Val Val Thr  
100 105 110

<210> 83  
<211> 107  
<212> PRT  
<213> potato

<400> 83

Met Val Lys Phe Ala His Val Val Ala Phe Leu Leu Leu Ala Ser Leu  
1 5 10 15

Ile Gln Pro Leu Thr Ala Arg Asp Leu Glu Ile Asn Val Leu Gln Leu  
20 25 30

Asp Val Ser Gln Ser Gly Cys Pro Gly Val Thr Lys Glu Arg Trp Pro  
35 40 45

Glu Leu Leu Gly Thr Pro Ala Lys Phe Ala Met Gln Ile Ile Gln Lys  
50 55 60

Glu Asn Pro Lys Leu Thr Asn Val Gln Thr Ile Leu Asn Gly Gly Pro  
65 70 75 80

Val Thr Glu Asp Leu Arg Cys Asn Arg Val Arg Leu Phe Val Asn Val  
85 90 95

Leu Asp Phe Ile Val Gln Thr Pro Gln Ile Gly  
100 105

<210> 84  
<211> 73  
<212> PRT  
<213> potato

<400> 84

Met Ser Ser Thr Glu Cys Gly Gly Gly Gly Gly Gly Ala Lys Thr Ser  
1 5 10 15

Trp Pro Glu Val Val Gly Leu Ser Val Glu Asp Ala Lys Lys Val Ile  
20 25 30

Leu Lys Asp Lys Pro Asp Ala Asp Ile Val Val Leu Pro Val Gly Ser  
35 40 45

Val Val Thr Ala Asp Tyr Arg Pro Asn Arg Val Arg Ile Phe Val Asp  
50 55 60

Ile Val Ala Gln Thr Pro His Ile Gly  
65 70

<210> 85  
<211> 70  
<212> PRT  
<213> potato

<400> 85

Thr Glu Phe Gly Ser Glu Leu Lys Ser Phe Pro Glu Val Val Gly Lys  
1 5 10 15

Thr Val Asp Gln Ala Arg Glu Tyr Phe Thr Leu His Tyr Pro Gln Tyr  
20 25 30

Asp Val Tyr Phe Leu Pro Glu Gly Ser Pro Val Thr Leu Asp Leu Arg  
35 40 45

Tyr Asn Arg Val Arg Val Phe Tyr Asn Pro Gly Thr Asn Val Val Asn  
50 55 60

His Val Pro His Val Gly  
65 70

<210> 86  
<211> 60  
<212> DNA  
<213> potato

<400> 86  
ggatccatga aactcttggc tgtgactcta ttggctttcg ccgcggtcgt ctccgcgagg 60

<210> 87  
<211> 18  
<212> PRT  
<213> potato

<400> 87

Met Lys Leu Leu Ala Val Thr Leu Leu Ala Phe Ala Ala Val Val Ser  
1 5 10 15

Ala Arg

<210> 88  
 <211> 40  
 <212> DNA  
 <213> artificial sequence

<220>  
 <223> FwBacRECH2 primer

<400> 88  
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 aacatttgca ccagcgggtg caacggcagg agcacttgcc gcggtgactc cggcggctct 720  
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<400> 91

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Asp Leu Glu Asp Ile Thr Ala Trp Gly Tyr Leu Thr Lys Phe Gly Ile  
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Pro Glu Ala Glu Lys Ile Arg Asn Ala Glu Glu Ala Ser Ser Ala Ser  
35 40 45

Arg Ile Val Gly Gly Ser Leu Ser Ser Val Gly Gln Ile Pro Tyr Gln  
50 55 60

Ala Gly Leu Val Ile Asp Leu Ala Gly Gly Gln Ala Val Cys Gly Gly  
65 70 75 80

Ser Leu Ile Ser Ala Ser Arg Val Leu Thr Ala Ala His Cys Trp Phe  
85 90 95

Asp Gly Gln Asn Gln Ala Trp Arg Phe Thr Val Val Leu Gly Ser Thr  
100 105 110

Thr Leu Phe Ser Gly Gly Thr Arg Ile Pro Thr Ser Asn Val Val Met  
115 120 125

His Gly Ser Trp Thr Pro Ser Leu Ile Arg Asn Asp Val Ala Val Ile  
130 135 140

Arg Leu Gly Thr Asn Val Ala Thr Ser Asn Thr Ile Ala Ile Ile Ala  
145 150 155 160

Leu Pro Ser Gly Ser Gln Ile Asn Glu Asn Phe Ala Gly Glu Thr Ala  
165 170 175

Leu Ala Ser Gly Phe Gly Leu Thr Ser Asp Thr Gly Ser Ile Ser Ser  
180 185 190



Asn Gln Ala Leu Ser His Val Asn Leu Pro Val Ile Thr Asn Ala Val  
195 200 205

Cys Arg Asn Ser Phe Pro Leu Leu Ile Gln Asp Ser Asn Ile Cys Thr  
210 215 220

Ser Gly Ala Asn Gly Arg Ser Thr Cys Arg Gly Asp Ser Gly Gly Pro  
225 230 235 240

Leu Val Val Thr Arg Asn Asn Arg Pro Leu Leu Ile Gly Ile Thr Ser  
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Phe Gly Ser Ala Arg Gly Cys Gln Val Gly Ser Pro Ala Ala Phe Ala  
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